sends a tongue northward from Rincon to the Vento on the Almendares River in the northern watershed. Aside from the 'Ojos de agua' along the edge of the cienegas skirting the southern coast there are two notable places where underground rivers find an exit; the one at Vento, as already mentioned, supplies the entire city of Havana with its water, the other serves to make the region about Guines a garden, its waters being used for irrigation. Other subterranean rivers in all probability have a subaqueous exit to the south.

The large spring at Vento is the only one on the northern slope as far as I know. The exact origin of the supply issuing from the Vento Spring has not been traced. But the region north of the Almendares River, being shut out from a possible contributing source, it undoubtedly derives its water from the tongue of the system of underground streams thrust into the northern slope. An examination of the best available map and the levels of the Western and United Havana Railroads makes it seem quite certain that the Vento Springs derive their water from the region immediately south of Vento and north of Rincon and Bejucal. This region contains various sinks without surface outlets, as well as dry sink-holes. A notable sink-hole in this region is that at Aquada on the United Havana Railroad. This is very broad, shallow and dry during the dry season but the water rises to stand over ten feet deep on the railroad track during some of the wet seasons. All of these probably drain into the Vento Springs.

It behooves the health authorities of the city of Havana to exercise the strictest guard over the region between Vento on the north and Rincon and Bejucal on the south. Any contamination of sink-holes in these regions is sure, during the wet season at least, to contaminate the underground streams leading to Vento. An examination of the underground channels in the Lost River region of Indiana has shown the main underground channels to be provided with numerous smaller tributary channels which in ordinary weather do not carry water, but which do carry water into the main stream after a long rain. At such a time any filth that may have accumulated in any of the sink-holes over one of the tributary streams is sure to find its way into the main stream. The same is very probably true of the Vento supply, although on account of the nature of the region it is not possible to follow the underground channels. At present some of the sink-holes between Rincon and Vento are used as cess-pools and receivers of sewage.

C. H. Eigenmann.

NOTES ON PHYSICS.

GROUP AND WAVE VELOCITY.

The question was raised at the Pittsburg meeting of the American Association, in a private discussion of Professor Brace's scholarly vice-presidential address, as to the physical distinction between wave and group velocity of light. Undoubtedly the best physical discussion of this matter is to be found in the remarkable chapter on plane electromagnetic waves in Chapter IV., Vol. I., of Heaviside's 'Electromagnetic Theory,' especially in his discussion of the generation of tails. A simple conception of the distinction between wave and group velocity is as follows: Imagine a stretched rubber tube with a series of equidistant weights suspended from the tube by helical springs and imagine a train of say one hundred equidistant similar waves to be started along this tube. The head of this wave train, as it runs out at full speed (wave speed) upon the previously stationary portion of the stretched tube, exerts upon each element of the tube a series of periodic forces, and because of the suspended weights these periodic forces require some perceptible time, ten or fifteen cycles, say, to establish the full oscillatory motion corresponding to the full amplitude of the wave train. Therefore, although the head of the wave train runs out on the tube at full speed, there is a gradual rise in amplitude from the extreme head backwards towards the middle of the train. Furthermore, as the main portion of the wave train leaves a portion of the tube this portion of the tube persists for an appreciable time in oscillations of diminish-

ing amplitude because of the suspended weights, so that the advancing wave train leaves behind it an ever-lengthening tail, of which the amplitude diminishes backwards. The extreme head of the wave train travels at what is called the *wave velocity* and the middle of the spreading train travels at what is called the *group velocity*. Strictly, the term *wave velocity* applies to the ratio wave-length divided by periodic time in the middle region of a train of waves so long that the diminishing amplitudes in head and tail are without influence.

It is a curious fact, as has been pointed out by Heaviside, that a periodic wave train in a dispersing medium is about the only kind of wave that can be put into simple mathematics, while a mere wave pulse is the only kind that is simple physically. Physically a wave train in a dispersing medium is a very complicated phenomenon.

VARIATION OF WEIGHT WITH CHEMICAL AND PHYSICAL CHANGES.

The electromagnetic theory of inertia, in which the inertia of matter is attributed to corpuscular electric charges in the structure of atoms, leads one to expect a decrease in the total inertia of two substances like H and O when they combine to form water for the following reasons. A moving electric charge has inertia. The amount of this inertia is determined by the extent to which the electric lines of force from the charge permeate surrounding space, for this determines the extent of the magnetic field which is produced by the movement of the charge. Most of the inertia effect is, however, in the region near the charge, for there the electric field and also its magnetic effect are greatest. Two adjacent opposite charges side by side have less electrical inertia than the same two charges widely separated, for the reason that the electric lines of force permeate less into remote regions of space.

If inertia and gravitation vary together we should thus expect a given amount of O and H to weigh less when these substances are combined to form water.

Very careful attempts have been made to detect changes in weight due to chemical changes by Landolt in 1893 and by Heydweiller in 1900, and the changes are so small as to be questionable. Attention was called in 'Physics Notes' several years ago in SCIENCE to the fact that a variation of weight (or mass) with chemical changes would by no means necessarily vitiate the principle of the conservation of matter, so that such changes, if they exist, are of most importance in their bearing upon the perplexing questions of gravity and inertia.

Recently it is announced that Professor Babcock has established the fact of the variation of weight with chemical and physical changes. He is reported to have used a special form of hydrostatic balance capable of detecting a change in weight of one part in a hundred million. This degree of refinement is in fact about that which can be reached by the ordinary balance, and when we remember that the temperature of his water-bath would, unless compensating devices are devised and used, have to be controlled to about 1/40,000 of a centigrade degree to enable him to avail himself unmistakably of a sensitiveness of one part in a hundred million, it seems doubtful that he could have realized a sensitiveness anything like as great as that at the disposal of Landolt in 1893, at the disposal of Heydweiller in 1900 and also at any one's disposal now in 1903. When the buoyant force of the air, only, is involved temperature must be controlled to about 1/400 of a centigrade degree to enable one to detect unmistakably so small a variation in weight as one part in a hundred million. W. S. F.

RESOLUTIONS OF THE NATIONAL EDUCATIONAL ASSOCIATION.

THE committee on resolutions at the Boston meeting of the National Educational Association, which consisted of Nicholas Murray Butler, of New York, Chairman; Andrew S. Draper, of Illinois; James M. Green, of New Jersey; Bettie A. Dutton, of Ohio; H. B. Frissell, of Virginia; prepared the following declaration, which was adopted by the association.